TRAWL APPARATUS

The present invention relates to a trawl apparatus equipped with a means for gathering seafood/biomass and conveying it to a seafood/biomass receiving vessel, as defined in more detail in the preamble of attached claim 1.

During a trawling operation, a trawl is towed behind a trawl vessel using adapted lines with or without otter boards, whereby seafood/biomass such as fish, shrimp and krill and/or other seafood/biomass is gathered in a trawl bag. After this trawl bag has been more or less filled with seafood/biomass, it is normally hauled on board the vessel and emptied. Alternatively, the trawl bag or sack may be emptied whilst floating alongside the vessel. Some types of seafood/biomass, such as for instance, krill, have a short liftetime after being gathered in the trawl and brought to the surface before they die and rapidly begin to decompose, their value as a raw material thus diminishing considerably. In general, it is important for all forms of seafood/biomass that it should come to the vessel undamaged and as quickly as possible for further processing, as delays in this process usually substantially diminish the quality of the seafood/biomass. Seafood/biomass that is subjected to rough handling and crushing through being gathered in a trawl bag and hauled on board the vessel, whereupon the trawl bag is emptied, or by mechanical pumping from the trawl bag for collection on board the vessel, will also be of reduced quality and value because of the damage it suffers. The reduction in value will also extend to by-products from seafood/biomass such as roe, liver or the like. Seafood/biomass that is caught in a traditional manner will also largely be dead the moment it comes aboard the vessel.

In connection with trawl bags, it is known to equip such a bag with a sorting grille or filtering grille to be able to separate out larger units of seafood/biomass and marine animals, as for instance larger fish. The apertures in the sorting or filtering grille will determine what marine animals or seafood/biomass are filtered out of the trawl bag. There are also prior art solutions for separating small fish from the catch using similar systems.

It has also previously been suggested to use different forms of mechanical pump solutions with an inlet opening in the end of the trawl bag so as to be able to pump the filtered content of the trawl bag directly up to a vessel on the surface, but the known solutions have not been particularly successful because of compression at the end of the trawl bag and frequent blockages.

For further illustration of the prior art reference is made to the teachings of US Patents 1447553 and 3440752 and Norwegian Patents 109811, 35544, 166512 and 313261.

Accordingly, there is a substantial need to be able to enhance the efficiency with which undamaged and living seafood/biomass gathered by the trawl is conveyed to a seafood/biomass receiving vessel. The invention is of particular importance for the gathering and conveyance of krill, shrimp and other types of seafood/biomass, including all forms of fish, where conveyance to a production vessel for further processing and continuous, non-stop preservation on board can take place in controlled forms during continuous or prolonged trawling

The apparatus mentioned in the introduction is characterised by the features set forth in the characterising clause of attached claim 1.

The apparatus is characterised in that it can advantageously be used during uninterrupted, continuous or prolonged trawling, where seafood/biomass is also in an uninterrupted or continuous manner over a long period conveyed up to a receiving vessel.

Advantageous embodiments of the apparatus are disclosed in the dependent claims.

The invention will now be described with reference to the attached figures.

Fig. 1 is a schematic illustration of a trawling operation which makes use of a first embodiment of the apparatus according to the invention.

Figs. 2 and 3 show on an enlarged scale details of the apparatus shown in Fig. 1, according to the invention.

Fig. 4 shows in even further detail the collecting cage that is an integral part of the apparatus shown in Figs. 1 and 3, according to the invention. Fig. 5 is a schematic view of a trawling operation which makes use of a second, preferred embodiment of the apparatus, according to the invention.

Figs. 6, 7 and 8 show on an enlarged scale details of the apparatus shown in Fig. 5, according to the invention.

Fig. 9 shows in even further detail the collecting cage that is an integral part of the preferred apparatus shown in Figs. 5 and 8, according to the invention.

Fig. 10 shows in more detail an example of a cleaning device for mounting in the collecting cage.

In Fig. 1 the reference numeral 1 indicates a trawl which with the aid of towing lines 2 with or without otter boards or other devices for spreading the trawl opening (not shown) is towed behind a trawl vessel 3. A conveying hose 4 extends from the trawl vessel 3 down towards the trawl and at its end is connected to a collecting cage 5, where the inlet end 5' of the cage 5 is connected to the rear end 1' of the trawl 1. In addition, from the vessel 3 there is provided a supply hose 6 which extends downwards and either is connected to the conveying hose 4 at a random point 4' on the hose 4 between the trawl and the vessel, preferably connected as shown in Fig. 2. Alternatively, the connection can be made at a point 4" close to the rear end 4"' of the conveying hose 4, as shown in Fig. 4, and the supply hose can then be run as indicated by the reference numeral 6' in Fig. 1. It is intended to pass a fluid, for example air or seawater, through the supply hose 6, which, by injector effect on introduction into the conveying hose 4 in the direction of the vessel 3, will cause suction of seafood/biomass via the collecting cage 5 and conveying hose 4 up to the vessel. Alternatively, the movement of fluid may be take place using the fluid displacement principle. In Fig. 1, the supply hose 6 is shown in part in a broken line to illustrate the case where it is connected at the point 4" as shown in Fig. 4. The supply hose 6 can also be uncoupled between the vessel 3 and the connection point 4". The principle of handling and arrangement of the hoses and line can be varied.

As indicated in Fig. 2 on an enlarged scale, a weight 7 may advantageously be attached to the conveying hose to ensure that this is held in position behind the vessel 3. This naturally applies also to the supply hose 6. Adjustment of the position of the weight relative to the height of the collecting cage can be done automatically using wireless sensors and computer-controlled winches.

The collecting cage 5 which is preferably arranged at the open end 1' of the trawl, is, as shown in Fig. 4, made in the form of an elongate body with an open front end 5' and a rear end 5" which passes into a funnel 8. The collecting cage 5 is made having walls 9, 9' and roof 9" and bottom 9"'. These walls, roof and bottom may be made in the form of

a grille or of a wire netting material or the like, the openings thus provided being suitable for straining water. The walls and roof and bottom may be modularly constructed of sections, as indicated by the reference numeral 10, and joined in an appropriate manner. The sections 10 may advantageously have a circular or polygonal cross-section. In Figs. 4 and 9 the collecting cage is shown, by way of example, having a square cross-section. Mounted on the collecting cage may be a movable or mechanical cleaning device 21, indicated in Fig. 9 and shown in the form of an example in Fig. 10.

At the open front end of the collecting cage 5, indicated by the reference numeral 5', there is, if desired/required, a cage section without a roof, as indicated by the reference numeral 11, so that the collecting cage 5 in that section is open at the top so as to be able to cooperate with a screen or grille 12 that extends from the bottom edge of the opening 5' inwards and upwards in the collecting cage 5. The purpose of the grille is to ensure that seafood/biomass, for example, fish, or foreign objects over a certain size do not pass through the grille, but are led up through the opening 11 and away from the collecting cage 5. It may also be an environmental requirement that fish which are not to be caught by the trawl should be automatically sorted away from the trawl. The grille can guide foreign objects through the opening in the roof of the cage as described above, or alternatively through the sides or bottom of the cage. In a simplified version, it is conceivable that the grille could be rotated 90° or 180° relative to that shown in Figs. 4 and 9 in order to make this possible. If the channelling away of foreign objects is intended to take place, for example, via two side walls, the grille could have a V-shape.

Suitable dimensioning of the apertures that will be found in the grille 12 will allow the grille to be adapted to sort away all objects that are larger than the desired seafood/ biomass, for example, krill, shrimp, fish or the like. As shown in Fig. 4, the said funnel 8 passes into a duct portion 13 that is suitably bent so that the duct 13 opening 13' is preferably arranged parallel to the longitudinal direction of the collecting cage 5. The duct 13 is connected to the conveying hose 4 at its end 4'''. The conveying hose 4 is, as indicated above, run up to the vessel 3, and the seafood/biomass that is conveyed to the vessel 3 can be collected on board and further treated or further processed, and preserved. On board the vessel, the conveying hose and the supply hose could be coiled on hose drums with centre runout and swivels to enable the hose length to be easily adjusted whilst the conveyance of seafood/ biomass up to the vessel continues. After or during the conveyance of the seafood/ biomass to the vessel 3, it must be separated from the seawater that accompanies it on its way up. This can be effected, if necessary, by

means of a deceleration device which reduces the conveying rate and a suitable screening box for seawater schematically indicated by the reference numeral 15. The fact that the trawl in this way can be emptied continuously whilst it is towed through the water is essential for the quality that the caught seafood/biomass will have, and will consequently also affect the quality of the finished product.

As the seafood/biomass can be conveyed continuously, undamaged and alive up to the vessel, it will also be possible to remove immediately any unwanted seafood/biomass on board and subsequently return it to the ocean in an undamaged and living form. The fisherman also has good control of what he catches and avoids catching large quantities of unwanted seafood/biomass in the trawl bag.

Guide fins 14, 14' which run in the longitudinal direction of the collecting cage 5 are preferably, but not necessarily, arranged on the outside of the collecting cage 5.

The amount of air or other fluid that is to be admitted into the conveying hose 4 by means of suitable devices on the vessel is optimised to facilitate the most efficient continuous emptying of the collecting cage 5 in order to provide optimum conveying conditions for the seafood/biomass that is to be gathered and conveyed up to the vessel.

A slightly more preferred embodiment of the invention, and which represents a modification of the embodiment that is shown and described in connection with Figs. 1-4, will now be described in more detail with reference to Figs. 5-9, and the main focus will be on the structural changes compared with the embodiment shown in Figs. 1-4. Elements in Figs. 5-9 which have the same design or the same function as that shown in the embodiment in Figs. 1-4 have been given the same reference numerals, and will not be described in more detail below.

Figs. 5-9 show a conveying hose 16 for conveying seafood/biomass gathered in the collecting cage 5 via the trawl 1 up to the trawler vessel 3. From Figs. 5 and 8, it can be seen that the hose 16 in a preferred embodiment runs along the underside of the trawl 1. Then, as shown in Figs. 8 and 9, the hose runs into the collecting cage 5 and preferably along the bottom 9''' thereof in the form of a conveying pipe 16' which at a rear section 5''' of the collecting cage passes into a guiding funnel 17. The funnel opening will advantageously face the back wall 9'''' of the collecting cage. As shown in Fig. 7, a weight 7 will be provided on the conveying hose 16 in order to hold it down, just as in the embodiment in Figs. 1 and 2, and the position of the weight may advantageously be

in an area where the conveying hose 16 goes from a portion 16" which is in the trawling direction to an upward extending portion 16'''. The weight 7 is connected to the vessel 3 via a connecting line 18, corresponding to that shown in Figs. 1 and 2.

Unlike the solution shown in Figs, 1, 3 and 4 where a fluid, preferably air, is supplied via the supply hose 6 either at a point 4" on the conveying hose 4 or at a point 4' on the conveying hose 4 at the position of the weight 7, in the solution illustrated in Fig. 5 a supply hose 19 supplies air or other fluid under pressure to an injector 20 which is connected to the conveying hose 16 at a point which is at a depth that is substantially smaller than the depth at which the trawl 1 and the collecting cage 5 are located. Thus, it is seen that the injector 20 is located in a upper part of the upward extending portion 16''' of the hose 16. The injector 20 causes substantial suction to be produced in the conveying hose, almost causing a siphon effect in order to draw up seafood/biomass from the collecting cage 5 via the funnel 17, conveying pipe 16' and the hose 16 to the vessel 3 via the injector 20. A considerable advantage of placing the injector 20 substantially closer to the vessel 1 than shown in Fig. 1, is that the conveying path for air or other fluid to the injector is shorter, which makes smaller demands as regards the fluid pressure that will be required in the supply hose 19 in order to bring the seafood/biomass up to the vessel, and thus reduces the power requirement needed for the supply of air or other fluid to the injector. It is also a great advantage in connection with, e.g., inspection, maintenance or the like of the injector 20 that it is not too far beneath the surface of the sea. Adjustment of the level at which the injector is positioned relative to the collecting cage can be done automatically using wireless sensors and computer-controlled winches.

Fig. 10 is a purely schematic illustration of the principle of a possible cage cleaning device 21 consisting of a rotating bladed wheel 22 where the blades 22', when they rotate about an axis of rotation 23 and are under a semi-circular cover 24, will be horizontal or almost parallel to the adjacent wall, bottom or roof of the collecting cage to reduce water resistance, whilst when the blades 22' move outside the front edge 24' of the cover, they will turn to stand almost perpendicular to the adjacent wall, bottom or roof of the cage.

As mentioned in the introduction, the gathering and conveyance of, for instance, krill and other biomass will be critical as regards time, as, the quality of, for example, krill that is to be further treated and processed may easily deteriorate because it dies too long before the processing takes place. Swift conveyance of living individuals up to the

vessel and thence directly to a continuous processing process has the effect of ensuring that the protein content and the quality of the gathered seafood/biomass is optimal and considerably better than what can be achieved with the known solutions. As also mentioned in the introduction, the quality of the seafood/biomass such as krill or fish that is first subjected to crushing during the gathering in the trawl bag and is then subjected to further crushing and damage when the trawl is hauled on board the vessel and emptied, or if the trawl is emptied by mechanical pumping, will also be enhanced by using the apparatus described, as the seafood/biomass is subjected to far less rough handling/damage during collection and conveyance to the vessel, and moreover it reaches the vessel whilst still alive.

Although the present invention will be especially suitable for the collection and conveyance of, for example, krill, it will be obvious that the apparatus can also be used for any form of seafood/biomass that has larger or smaller individual dimensions or form. Thus, it should be clear that the invention is not limited to use at sea, but can just as readily be used in fresh water or inland waters or lakes.

The design of the collecting cage 5 shown in the figures is of course not a limitation as regards how the collecting cage may be designed and equipped, or of what suitable materials it is made. There may, for example, be provided devices known per se in the form of sensors, which, for instance, may be wireless, for monitoring the position of the collecting cage in the water, depth, flow etc.

Although the use of filtering grille 12 has been illustrated and described, it may in some circumstances be neither necessary nor desirable.